

Eumops underwoodi. By W. Mark Kiser

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Eumops Miller, 1906

Eumops Miller, 1906:85. Type species *Molossus californicus* Merriam.

Molossides G. M. Allen, 1932:257. Type species *Molossides floridanus* G. M. Allen.

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Molossidae. The genus *Eumops* contains nine species; *E. auripendulus*, *E. bonariensis*, *E. dabbenei*, *E. glaucinus*, *E. hansae*, *E. maurus*, *E. perotis*, *E. trumbulli*, and *E. underwoodi* (revised by Eger, 1977). A key to the species of *Eumops* as modified from Eger (1977) follows (measurements are in mm):

- 1 Length of forearm <55; length of cranium <22 _____ 2
Length of forearm >55; length of cranium >22 _____ 4
- 2 Band of white hair (ca. 5 mm wide) between humerus and femur on ventral surface of mesopatagium proximal to body; remainder of body dark chocolate; length of forearm 51-53 _____ *E. maurus*
No white band on ventral surface of mesopatagium; length of forearm <50 _____ 3
- 3 Dorsal pelage rich blackish-brown; ventral pelage white at base; basisphenoid pits deep and long; length of forearm 37.0-41.2; length of cranium >45% of length of forearm _____ *E. hansae*
Dorsal pelage snuff brown to bistre; basisphenoid pits shallow



FIG. 1. *Eumops underwoodi sonoriensis* from Pima Co., Arizona: Photograph by J. S. Altenbach.

- and small; length of forearm 36.9-49.4; length of cranium <45% of length of forearm _____ *E. bonariensis*
- 4 Ears long, 40 (range, 35-44); tragus large, broad, and square; basisphenoid pits deep and elongate; width of mastoid <52% of condyloincisive length _____ 5
Ears short, generally <35 (range, 17-34); tragus small, pointed, or square; basisphenoid pits shallow; width of mastoid >52% of condyloincisive length _____ 6
- 5 Third commissure of M³ 25% of length of second _____ *E. perotis*
Third commissure of M³ 50% of length of second; length of forearm 70.9 (range, 67.4-75.0); length of cranium 28.7 (range, 26.8-31.0); lacrimal width 8.1 (range, 7.3-9.1) _____ *E. trumbulli*
- 6 Size large, length of cranium >28 (males) and >27 (females); ear heavily keeled; dorsal pelage cinnamon with buff basal band _____ 7
Size small, length of cranium <28 (males) and <27 (females); pelage snuff brown to sepia (with white basal band) or blackish brown; ear not heavily keeled _____ 8
- 7 Length of forearm 77.1 (range, 74.5-79.0); length of cranium 33.8 (range, 32.1-34.8); length of cranium >32 (females only); known only from South America _____ *E. dabbenei*
Length of forearm 69.7 (range, 64.3-76.1); length of cranium <32 (females) and <33 (males); small number of guard hairs on rump extending 7-10 mm beyond the rest of the pelage; known only from Honduras north to Arizona and New Mexico _____ *E. underwoodi*
- 8 Tragus small and pointed; dorsal pelage blackish brown; basisphenoid pits shallow; width of mastoid <49% of length of cranium _____ *E. auripendulus*
Tragus broad and square; dorsal pelage snuff brown to bistre with white basal band; basisphenoid pits well defined; width of mastoid >52% of length of cranium _____ *E. glaucinus*

Eumops underwoodi Goodwin, 1940

Underwood's Mastiff Bat

Eumops underwoodi Goodwin, 1940:2. Type locality "El Pedrero, 6 km. N Chinacla [=Chinacila], approximately 3,000 ft. elevation, Dept. La Paz, Honduras."

Eumops sonoriensis Benson, 1947:133. Type locality "Rancho de Costa Rica, 270 ft. elevation, Rio Sonora, Sonora, Mexico."

CONTEXT AND CONTENT. Context noted in generic summary above. Two subspecies of *E. underwoodi* are recognized (Hall, 1981):

- E. u. sonoriensis* Benson, 1947:133, see above.
E. u. underwoodi Goodwin, 1940:2, see above.

DIAGNOSIS. *Eumops underwoodi* superficially resembles other North American free-tailed bats (Fig. 1). However, it is distinguished from other molossids by its large size, bristle-like rump hairs, heavily keeled ears, reduced tragus, heavy mandible, and smooth upper lips (Barbour and Davis, 1969; Benson, 1947; Eger, 1977). *E. underwoodi* is most similar to *E. dabbenei* of South America (Eger, 1977). *E. dabbenei* proportionally is larger than *E. underwoodi* in wing characters and smaller in skull characters. *E. dabbenei* is slightly larger; ears, tragus, and pelage are similar. The ranges of *E. dabbenei* and *E. underwoodi* do not overlap (Eger, 1977).

In North America, *E. underwoodi* is most similar to *E. perotis*, which is slightly larger. *E. underwoodi* and *E. perotis* are among the largest members of their genus (Freeman, 1981), and are the largest bats found in the United States. *E. underwoodi* has a small

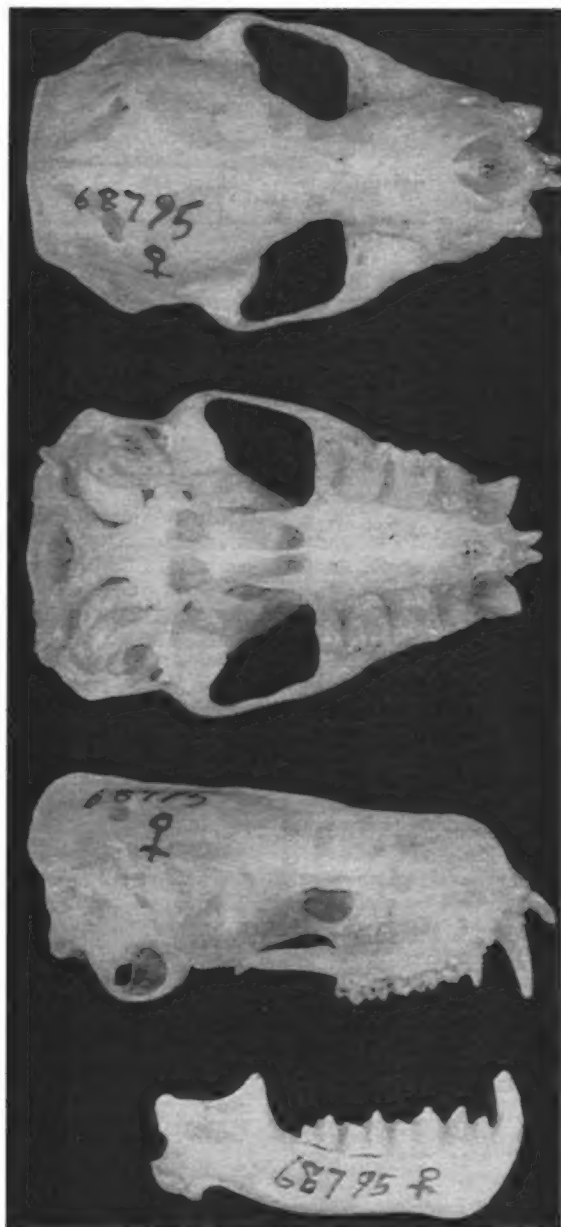


FIG. 2. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of *Eumops underwoodi underwoodi* from near Nejapa, Oaxaca, Mexico (female, University of Kansas Museum of Natural History 68795). Greatest length of cranium is 29.8 mm. Photographs by T. H. Henry.

number of bristle-like guard hairs on the rump that extend 7–10 mm beyond the rest of the pelage, which are absent in *E. perotis* (Barbour and Davis, 1969). The length of forearm for *E. perotis* is 72–82 mm and the wingspread is 530–570 mm. The length of forearm for *E. underwoodi* is 65–77 mm and the wingspread is 500–540 mm (Barbour and Davis, 1969). The ears of *E. perotis* are slightly longer than those of *E. underwoodi*, measuring ca. 40 mm from the notch; reaching beyond the nose when laid forward. In *E. underwoodi*, the ears are ca. 30 mm long and just reach the tip of the nose when laid forward (Barbour and Davis, 1969). The tragus of *E. underwoodi* is small and rounded, rather than broad and square as in *E. perotis* (Hoffmeister, 1986). Compared with *E. perotis*, the skull of *E. underwoodi* (Fig. 2) is shorter, wider, and more robust; basisphenoid pits are ca. 50% as large (Benson, 1947; Eger, 1977). The interorbital region is distinctly hourglass-shaped rather than nearly cylindrical (Benson, 1947). The dentary of *E. underwoodi* is relatively thick, like that of *E. auripendulus*. *E. perotis* has the thinnest dentary of any *Eumops* (Freeman, 1981).

Compared with *E. underwoodi*, *E. glaucinus* is smaller, darker,

and lacks the bristle-like guard hairs on the rump (Barbour and Davis, 1969). The skull of *E. u. sonoriensis* is ca. 50% greater in bulk than that of *E. glaucinus* (Benson, 1947). Within the United States, these two species are widely separated geographically (Barbour and Davis, 1969). No close comparison is needed with any other species of *Eumops* (Benson, 1947).

Eumops underwoodi also resembles *Nyctinomops macrotis*, with which it is sympatric, but is somewhat larger (Hoffmeister, 1986; Milner et al., 1990). The wingspread of *N. macrotis* is considerably less (417–436 mm versus 500–540 mm), and the mass of *N. macrotis* generally is <30 g rather than >40 g for *E. underwoodi* (Barbour and Davis, 1969). The mandible of *N. macrotis* is long and delicate, whereas that of *E. underwoodi* is thick and heavy. The upper lips of *N. macrotis* are deeply furrowed by wrinkles, unlike the smooth upper lips of *E. underwoodi* (Freeman, 1981; Milner, 1990).

GENERAL CHARACTERS. *Eumops underwoodi* is a large bat with long, narrow wings. The skull is heavy, robust, and rather cylindrically shaped. The skull also is short, wide, and strongly ridged (Eger, 1977; Hall, 1981). The basisphenoid pits are oval, shallow, and moderately well-developed (Eger, 1977). The dental formula is $i\ 1/2$, $c\ 1/1$, $p\ 2/2$, $m\ 3/3$, total 30 (Goodwin, 1969). A small PM^3 is present; third commissure of M^3 is rudimentary (Eger, 1977; Freeman, 1981). The ears are moderately large, heavily keeled, and the tragus is small, blunt, and rounded. The antitragus is large and low (Eger, 1977; Goodwin, 1940). The distal one-half of the tail is free from the uropatagium (Barbour and Davis, 1969; Eger, 1977). The pelage is cinnamon brown to mummy brown above (color nomenclature follows Ridgway, 1912—Eger, 1977) and somewhat grayish below. The hair is bicolor, paler at the base (Barbour and Davis, 1969).

Compared with *E. u. sonoriensis*, *E. u. underwoodi* is larger in body size, length of forearm, and in cranial dimensions (Eger, 1977). There is a clinal increase in size from north to south in *E. u. underwoodi* (Dolan and Carter, 1979). Average and range of measurements (in mm) of nine female *E. u. underwoodi* from Nicaragua, are: length of forearm, 73.4 (70.1–76.3); condylobasal length, 29.0 (28.4–29.5); zygomatic width, 18.4 (18.2–18.9); length of maxillary tooththrow, 11.8 (11.6–12.1); greatest width across upper molars, 12.4 (12.1–12.5—Dolan and Carter, 1979). Measurements of specimens from Jalisco, Mexico, differ slightly. External measurements (in mm) of an adult male, followed by the average and range of four adult females, are: total length, 155, 156 (150–162); length of tail, 49, 50 (48–52); length of foot, 19, 18 (17–18); length of ear, 32, 32 (32–33); length of forearm, 70.0, 70.9 (69.4–72.3); mass (in g), 66.5, 65.6 (63.9–66.7). Cranial measurements of the male and three females, respectively, are: condylobasal length, 28.1, 27.4, 27.6, 27.4; zygomatic width, 18.4, 17.9, 17.9, 18.0; postorbital constriction, 5.8, 5.7, 5.8, 6.0; rostral width, 10.5, 10.0, 10.3, 10.0; length of maxillary tooththrow, 11.8, 11.5, 11.5, 11.6 (Watkins et al., 1972).

Average and range of measurements (in mm) of 11 (10 females, 1 male) *E. u. sonoriensis* from Sonora, Mexico, are: total length, 167 (159–185); length of tail, 56 (44–67); length of foot (dry) 16.3 (15.0–17.5); length of ear from notch, 29 (27–30); length of forearm, 67.4 (65.3–69.8); condylobasal length, 26.7 (26.1–28.0); zygomatic width, 17.4 (16.7–17.9); lacrimal breadth, 9.9 (9.2–10.2); mastoid breadth, 15.2 (14.8–15.7); least interorbital width, 5.7 (5.4–5.9); width at M^3 , 11.9 (11.5–12.2); length of maxillary tooththrow, 11.4 (11.1–11.7); width of M^2 , 3.6 (3.5–3.8); mass (in g), 47.9 (40.0–55.6—Benson, 1947).

Comparisons of these measurements with those reported by Cockrum and Gardner (1960) for 15 specimens (seven males, eight females) from Pima Co., Arizona, reveal few differences. However, mass of the specimens is a notable exception. The average and range of mass (in g) of the 11 bats from Sonora were 47.9 (40.0–55.6) and for the 15 specimens from Arizona, males were 56.8 (53.0–60.5) and females were 57.3 (54.1–65.3). This may be due to seasonal differences, as the bats from Sonora were taken in May and those from Arizona were taken in July (Cockrum and Gardner, 1960).

The ears of *E. u. sonoriensis* are close together, but not joined on the forehead as in *E. u. underwoodi* and *E. perotis* (Benson, 1947). The forearm of *E. u. sonoriensis* averages ca. 67 mm, whereas the forearm of *E. u. underwoodi* averages ca. 71 mm (Benson, 1947; Eger, 1977). Compared with *E. u. underwoodi*, the skull of *E. u. sonoriensis* is more delicate in structure, the braincase

is relatively less inflated, and the lambdoidal crest is relatively wider and less sharply distinct from the ridge running to the mastoid processes. The basisphenoid pits are smaller and less-sharply defined; the dentition is less massive (greatest width of M^2 averages 3.6 for *E. u. sonoriensis* compared with 4.3 for *E. u. underwoodi*—Benson, 1947).

The pelage of the two subspecies differs slightly. The upper parts of *E. u. sonoriensis* vary from cinnamon brown to mummy brown; the underparts are avellaneous (Baker, 1956; Eger, 1977). *E. u. underwoodi* varies from sayal brown to bister dorsally, and is paler ventrally (Eger, 1977).

DISTRIBUTION. *Eumops underwoodi* occurs from southern Arizona to Honduras and Nicaragua (Fig. 3; Dolan and Carter, 1979; Eger, 1977; Hall, 1981; Villa-R., 1967). *E. u. underwoodi* occurs from Chihuahua, Mexico, to Honduras, Belize, and Nicaragua. *E. u. sonoriensis* occurs from southern Arizona to Sonora, Mexico (Eger, 1977). No fossils of *E. underwoodi* are known.

FORM AND FUNCTION. The baculum of *E. underwoodi* is similar in shape to those of *E. bonariensis* and *E. glaucinus*. Viewed dorsally, the baculum is rounded and broad at the base, constricted ca. 33% of the distance from the base, then rodlike to the tip. In one specimen, the bone is expanded immediately before the constriction and the distal tip is swollen. The baculum is heavy and strongly bowed ventrally; it tapers to a varying degree, both distally and proximally (Brown, 1967). Average and range of measurements (in mm) of bacula for two specimens of *E. u. sonoriensis* are: greatest length, 0.51 (0.45–0.58); greatest width at base, 0.09 (0.08–0.11); greatest distance, in lateral aspect, from the ventral surface to a line connecting the lowermost basal and distal projections, 0.10 (0.10–0.10—Brown, 1967).

In general, the wings of *Eumops* are well-adapted for rapid, prolonged flight (Vaughan, 1959). *E. underwoodi*, like most molossids, has extremely narrow, long-tipped wings for its size. Molossids exhibit some difficulty in taking flight from the ground, and often roost high in buildings, cliffs, and caves where they may free-fall to achieve sufficient momentum for flight (Schmidly, 1991). Molossids are known to migrate long distances and to travel long distances from roost to foraging areas. This wing structure is adapted to high-speed flight in open areas; high-speed flight apparently is correlated with high aspect-ratios. The flight speed of *E. underwoodi* is at least 43.2 km/h, but this may be an underestimate (Findley et al., 1972). The high aspect-ratio for *E. underwoodi* gives it one of the fastest flight speeds for molossids. *E. perotis*, the fastest molossid, has the highest aspect-ratio (Vaughan, 1966).

ONTOGENY AND REPRODUCTION. *Eumops underwoodi* apparently gives birth to one young in late June or in July (Barbour and Davis, 1969). A female on 18 May in Pima Co., Arizona, was pregnant. On 7 July, it gave birth in captivity to a bare female. One female captured 1 month later at the same locality was nongravid (Constantine, 1961). In July, a female from Sasabe, Pima Co., Arizona, contained one embryo, which measured 30 mm in crown-rump length. Seven of eight females from the same locality in July were lactating, and the other contained a 39-mm embryo that was near term (Cockrum and Gardner, 1960).

On 27 July, nine females from Boaco, Nicaragua, were lactating; length of testis for three males was 14, 13, and 13 mm (Dolan and Carter, 1979). On 3 August, a female from Chiapas, Mexico, was lactating (Alvarez and Aviña, 1964). Two females from Arriaga, Chiapas, Mexico, were nongravid (Carter et al., 1966). In July, an adult female from San Salvador, El Salvador, weighed 64.7 g and was lactating (Hellebuyck et al., 1985). On 7 June, a female from Michoacan, Mexico, had a mass of 57.6 g and contained one embryo (Burt, 1961). Of eight specimens from Jalisco, Mexico, on 21 October, four were nongravid adult females, three were juvenile females that lacked prominent mammae and had poorly fused phalangeal epiphyses, and one was an adult male (length of testis, 11 mm—Watkins et al., 1972).

ECOLOGY. Information on the habitat of *E. underwoodi* is scarce; winter distribution is unknown (Barbour and Davis, 1969). On 21 October in Jalisco, Mexico, nine *E. u. underwoodi* were present in pine-oak (*Pinus-Quercus*) forests at 1,495–1,800 m elev. Eight of these were roosting in a large, hollow tree (Watkins et al., 1972). On 6 April, in Jalisco, Mexico, a female was captured in a mist net over an arroyo at Juntas del Salitre (Mitchell, 1965). On 7 June, in Michoacan, Mexico, several *E. underwoodi* were observed

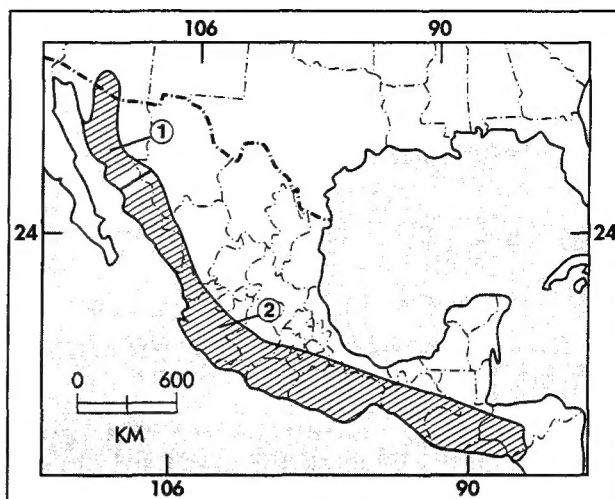


FIG. 3. Geographic distribution of *Eumops underwoodi* (Hall, 1981; Villa-R., 1967): 1, *E. u. sonoriensis*; 2, *E. u. underwoodi*.

feeding shortly after sundown. They flew high and in a fairly straight course back and forth over a narrow strip (Burt, 1961). *E. u. underwoodi* has been captured with *E. glaucinus* in Chiapas, Mexico, in tropical deciduous forest with some areas converted to grassland (Carter et al., 1966). An adult female from San Salvador, El Salvador, was present during the day in July beneath a leaf of a royal palm (*Roystonea*—Hellebuyck et al., 1985).

In the United States, *E. underwoodi* primarily is known from specimens collected in the vicinity of the Baboquivari Mountains, Pima Co., Arizona. The first record of *E. u. sonoriensis* in the United States was an adult male taken on 5 May at 1925 h over a watering tank near the southeast base of the Baboquivari Mountains (Baker, 1956). In July, two males were taken over a reservoir in Pima Co. (Hoffmeister, 1959). Many have been captured in mist nets set over a watering tank near Sasabe, Arizona, a few hundred meters north of the Mexican border (Barbour and Davis, 1969; Cockrum and Gardner, 1960). This tank, formed by an earthen dam, locally is known as Garcia's Represso. It is a catch basin for runoff water and is used to supply water for livestock. The water level varies considerably during the year, but it rarely is dry. The tank is in mesquite (*Prosopis*) desert at 1,220 m elev. (Cockrum and Gardner, 1960). The bats seem to be common at this locality, but the location of the diurnal roost is unknown (Barbour and Davis, 1969).

On 16 July, Cockrum and Gardner (1960) set three mist nets over this tank and captured 11 *E. underwoodi*. The water level was low; only 45.7 cm at the deepest parts and covered an area ca. 30.5 by 10.7 m. The first *E. underwoodi* was netted at 2045 h and by 0000 h six more had been captured. Between 0000 and 0330 h one more was captured; between 0330 and 0500 h three more were caught. Eight of the 11 bats were females. On 25 July, seven *Eumops* were captured (five males, two females). The water level was lower this time; the deepest parts averaged 22.9–25.4 cm, and the water covered an area ca. 6.1 by 15.3 m. On 19 June, 20 *E. underwoodi* of both sexes were caught in mist nets set over this tank. Bats were still flying over the tank at 0000 h as evidenced by their piercing calls (Barbour and Davis, 1969).

The roosting habits of *E. u. sonoriensis* probably are similar to those of *E. perotis*, i.e., it lives in high, dry places (Freeman, 1981). *E. perotis* roosts in high cliffs and is reported to free-fly before it can fly (Vaughan, 1959).

The diet of *E. underwoodi* differs from that of *E. perotis*. Stomachs of six *E. u. sonoriensis* from Pima Co., Arizona, contained: 47% scarab beetles (Scarabaeidae), 6–10 mm in length; 31% short-horned grasshoppers (Acrididae), 6–10 mm in length, some were *Trimerotropis pallidipennis*; 12% leafhoppers (Cicadellidae), 6 mm in length; 10% moths (Lepidoptera). Some leaf beetles (Chrysomelidae) and traces of planthoppers (Fulgoroidea), 20 mm in length, also were found. The stomach of one *E. u. underwoodi* from Michoacan, Mexico, contained four large (40 mm) June beetles (Scarabaeidae) and two larger (60 mm) long-horned beetles (Cerambycidae—Ross, 1967). Difference in jaw structure between *E. underwoodi*, *E. perotis*, and *N. macrotis* may be related to the type of prey eaten. The thick jaws of *E. underwoodi* are suited for hard



FIG. 4. Karyotype of *Eumops underwoodi sonoriensis* from near Sasabe, Pima Co., Arizona (Warner et al., 1974).

items such as beetles whereas the thin jaws of *E. perotis* and *N. macrotis* are more suited for soft-bodied insects such as moths (Freeman, 1981; Milner et al., 1990; Strait, 1993).

BEHAVIOR. The presence of *E. underwoodi* can be detected by listening for high-pitched "peeps" emitted several times a minute in flight. Observers have noted that the piercing calls of *E. underwoodi* are more intense than those of *E. perotis*, and that the calls are intense enough to hurt the ears of anyone standing close by (Barbour and Davis, 1969). Sounds tend to increase in frequency and intensity as *E. underwoodi* approaches ponds (Constantine, 1961); however, it may not call when approaching ponds (Barbour and Davis, 1969). Several *E. underwoodi* in Oaxaca, Mexico, appeared late in the evening and flew high. One of the bats could be detected by its loud calls (Arnold and Schnewald, 1972).

Eumops underwoodi is easy to handle in captivity and can be trained to eat mealworms. One female born in captivity would squeak to attract attention, scamper across its cage to greet visitors, jump into a gloved hand for feeding, and squeak when visitors left (Constantine, 1961).

GENETICS. The karyotype of *E. underwoodi* (Fig. 4) has a diploid number of 48 chromosomes; the fundamental number is 56. The autosomes consist of one large pair of metacentrics, two pair of medium-sized submetacentrics, and a graded series of 18 pair of acrocentrics. The X chromosome is a medium-sized submetacentric and the Y is a small acrocentric; sex chromosomes appear identical to those of *Tadarida brasiliensis* and *E. perotis* (Warner et al., 1974).

REMARKS. *Eumops* is derived from the Greek *eu* meaning good and the Malayan *mops* meaning bat (Jaeger, 1955). The specific epithet *underwoodi* is named to honor the collector of the type specimen, C. F. Underwood (Goodwin, 1940). I thank T. Rodriguez for preparing Fig. 3. J. S. Altenbach, T. L. Best, J. L. Eger, J. S. Findley, and an anonymous reviewer critically evaluated an early draft of the manuscript.

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